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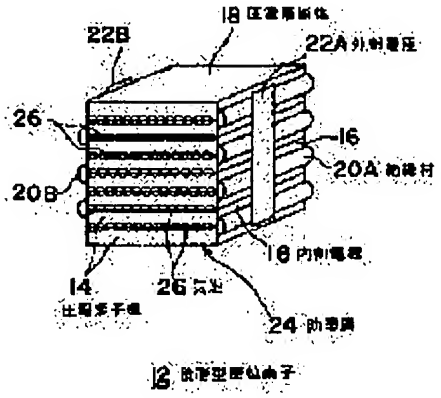
(54) LAMINATED DISPLACEMENT ELEMENT AND MANUFACTURE THEREOF

(57)Abstract:

PURPOSE: To provide a laminated displacement element, wherein cracks produced in a moisture-resistant layer formed of material not permeable to water are controlled in directions, and a method of manufacturing thereof.

CONSTITUTION: Piezoelectric element boards 14 and inner electrodes 16 are alternately laminated to form a laminate 18, and outer electrodes 20A and 20B connected to every other one out of the inner electrodes 16 are provided to the side faces of the laminate 18 for the formation of a laminated displacement element, wherein a moisture-resist ant layer 24 is provided to the other side faces of the laminate 18 where the outer electrode 16 is not provided, and a large number of air bubbles 26 are provided along the ends of the inner electrodes 16. By this setup, when a laminated displacement element is kept in operation, the arrangement of air bubbles is made to function as a cutting line to enable cracks to be produced along the arrangement of air bubbles so as to prevent cracks from spreading over the adjacent inner electrodes when cracks are generated in a moisture-resistant layer.



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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] the laminating mold which uses this invention for the positioning device of an X-Y stage, an ultrasonic motor, etc. -- a variation rate -- the laminating mold which can be applied to a component and can raise moisture resistance especially -- a variation rate -- it is related with a component and its manufacture approach.
[0002]
[Description of the Prior Art] The laminating mold piezoelectric device generally used for the component for very small displacement used for the positioning device of an X-Y stage , the ultrasonic motor , etc. be formed by joining with the adhesives of an organic system through direct or a thin metallic conductor , after preparing and polarizing an electrode in the sheet metal which consist of a piezo-electric ceramic ingredient into which the predetermined configuration be processed . However, adhesives absorb the variation rate by oscillation of a piezoelectric device according to a service condition, or some which carried out the laminating in this way using adhesives have the fault of deteriorating in adhesives by the hot environment or prolonged activity.
[0003] For this reason, recently, the laminating mold piezoelectric device of a laminating chip capacitor structure method is put in practical use. That is, for example like the publication to JP,59-32040,B, the piezo-electric ceramic ingredient of the shape of a paste which added the binder to raw material powder and was kneaded to it is formed in the sheet metal of predetermined thickness, electrical conducting materials, such as silver-palladium, are applied to one field or both sides of this sheet metal, and an internal electrode is formed. After carrying out the number laminating of predetermined leaves of the above-mentioned sheet metal, sticking it by pressure and processing a further predetermined configuration, by calcinating, it ceramic-izes and an external electrode is formed in the both-sides side of a layered product. Since a thermal property is also stable, the laminating mold piezoelectric device of the above-mentioned configuration is fully usable also in hot environments, and has an advantage, like there is very little degradation over a long period of time while it is excellent in the adhesion of the joint of the sheet metal which consists of a piezo-electric ceramic ingredient, and an internal electrode.
[0004] In the laminating mold piezoelectric device of the above-mentioned configuration, when the ingredient of a silver system is used as an electrode material, especially, in the case of the activity gestalt of carrying out continuation impression of the direct-current high tension of 100V-150V like electronic parts inter-electrode, and obtaining a variation rate, the so-called migration is produced in a high humidity ambient atmosphere, and there is a trouble of resulting in ********** at last in it. That is, although Ag which constitutes an electrode is an element which is easy to oxidize, it ionizes in a high humidity ambient atmosphere (Ag+), this complex ion moves to the negative electrode along with a surface from a positive electrode with applied voltage, and this deposits it on a negative electrode side. Such a deposit grows in the shape of a cedar leaf with the passage of time, reduces inter-electrode insulation resistance and ****** it at last. The proposal of covering the exposed part of the internal electrode formed with the silver system ingredient with the film which consists of a metal which has a

migration property smaller than silver as a means to prevent such migration is made (for example, refer to JP,62-62571,A).
[0005] However, after forming in a layered product, the activity which covers an exposed part cannot necessarily be thoroughly covered with a metal membrane, for example, may permit trespass of external moisture through a pinhole etc., and has a still dissatisfied point in respect of dependability while it is very complicated. Then, in order to raise moisture resistance, various kinds of approaches shown below are proposed. On the front face of the layered product 4 which has an internal electrode 2 as it indicates drawing 11 that it is indicated by JP,62-88382,A as a means to prevent trespass of the moisture in the ambient atmosphere of high humidity The organic poly membrane 6 which has elasticity is formed in the whole surface, one layer or two or more organic poly membranes 7 are further formed on it, trespass of moisture is intercepted by these poly membranes, and migration, such as (Silver Ag)-palladium (Pd) which constitutes the ingredient of an internal electrode, is prevented.
[0006] Moreover, as it indicates drawing 12 that it is indicated by JP,63-16685,A, it covers by the inorganic glass membrane 8 to set further the edge of the internal electrode 2 of + pole which consists of silver-palladium exposed to this in the side face in which the external electrode of a layered product 4 is not prepared, and trespass inside of moisture is intercepted. This controls that migration occurs from the internal electrode of + pole. Furthermore, as it indicates drawing 13 that it is indicated by JP,1-146379,A, the resin layer 9 is formed in the front face of a layered product 4, this layered product 4 whole is sealed and held for example, in the metal can 10 made possible by telescopic motion like bellows, and trespass inside of moisture is prevented.
[0007]
[Problem(s) to be Solved by the Invention] By the way, although the component side face is covered with resin if it is in the structure shown in above-mentioned drawing 11 , fundamentally, moisture invades gradually as it is used from the ability of trespass of moisture not to be severed thoroughly, since it has moisture permeability or hygroscopicity, although it is small, and resin has not become an essential improvement. Moreover, if it is in the structure shown in drawing 12 , the glass membrane 8 excellent in moisture resistance is formed in the electrode edge exposed to the side face of a layered product 4, and damp-proof improvement is expected. However, if it is in this approach, in order to form glass membrane 8, there was a trouble that electrify glass powder in a liquid, and had to use the electrophoresis method of making + electrode deposit this electrostatic, therefore a routing counter increased, and it was obliged to cost lifting.
[0008] Furthermore, although a damp-proof big improvement is expectable since the whole component is held in the bellows-like metal can 10 if it is in the structure shown in drawing 13 in this case, it is not only obliged to enlargement and the cost high of the whole equipment, but [since a metal can 10 is used,] When setting a component in a metal can 10 and this was not set proper, there was a possibility that an unbalanced load might be applied to this at the time of component operation, and breakage etc. might arise, and there was also a problem of reducing dependability.
[0009] In order to solve a trouble which was described above, coating the whole side-face surface of a layered product with inorganic glass membrane uniformly, and it being burned on it, and fixing is also considered, but when an electrical potential difference is impressed between + of a component, and the - internal electrode 2, this is worked and it is made to expand and contract in this case as shown in drawing 14 , it is not avoided that a crack 12 occurs in the above-mentioned glass membrane. When such a crack 12 arises in parallel along the edge of an internal electrode, although not generated, moisture cannot invade along with this part, a problem cannot serve as an electric path, if it is generated ranging over the internal electrode of + and - as this crack 12 shows drawing 14 , and the problem that the two electrodes of + and - will connect too hastily can seldom produce and adopt it. This invention is originated paying attention to the above troubles that this should be solved effectively. the laminating mold which can control the direction of the crack formed in the damp proof course which the object of this invention becomes from the non-water permeability matter -- a variation rate -- it is in offering a component and its manufacture approach.
[0010]

[Means for Solving the Problem] this invention person used to result in this invention by this carrying out the so-called operation of a perforated line, and acquiring the knowledge that the generating direction of a crack is controllable by making the damp proof course which was uniformly formed in the side face of a layered product and which consists of glass, for example arrange many air bubbles.
[0011] In a component namely, the laminating mold which prepared the external electrode connected for setting further with this internal electrode in the side face of the layered product which comes to carry out the laminating of a piezoelectric-device plate and the internal electrode by turns in order that this invention equipment might solve the above-mentioned trouble -- a variation rate -- It has the damp proof course which consists of non-water permeability matter formed in the side face in which said external electrode of said layered product is not prepared, and the air bubbles of a large number formed into said damp proof course along the edge of said internal electrode.
[0012] Moreover, in order to solve the above-mentioned trouble, this invention approach carries out the laminating of a piezoelectric-device plate and the internal electrode by turns, and forms a layered product. In the manufacture approach of the laminating type displacement component carried out as [prepare / in the side face of this layered product / the external electrode connected for setting further with said internal electrode] A gas generating member is formed along the edge of said internal electrode on the side face in which said external electrode of said layered product is not prepared. Subsequently The damp proof course which consists of non-water permeability matter is formed in the side face in which said external electrode of said layered product is not prepared, and many air bubbles are formed into said damp proof course along the edge of said internal electrode by generating a gas from said gas generating member after that.
[0013]
[Function] Since this invention is constituted as mentioned above, many air bubbles generate it in a damp proof course like glass membrane along the edge of an internal electrode. The generating principle of these air bubbles is CO2 by the chemical reaction by heating this using a gas generating member like SiC (silicon carbide). It generates. Thus, it becomes possible to raise the moisture resistance of a component, without becoming the inclination which a crack generates in accordance with the array of the above-mentioned air bubbles, therefore a crack's not occurring ranging over the internal electrode of + and -, and complicating a production process, when this expands and contracts at the time of component operation, if many air bubbles arrange in a damp proof course.
[0014]
[Example] Below, one example of the laminating type displacement component of this invention and its manufacture approach is explained in full detail based on an accompanying drawing. the laminating mold which drawing 1 requires for this invention -- a variation rate -- the perspective view showing a component, and the variation rate which shows drawing 2 to drawing 1 -- process drawing showing the production process of a component, and the variation rate which shows drawing 3 to drawing 1 -- it is the top view of a component. The piezoelectric-device plate 14 with which this laminating type displacement component 12 consists of a tabular ceramic piezoelectric material so that it may illustrate, The internal electrode 16 which consists of silver-palladium or platinum For example, number of sheets predetermined by turns, It has the piezo-electric layered product 18 formed by carrying out the laminating of about several ten sheets. For example, to one side of the side faces of the couple of this layered product 18 It covers to set the edge side of an internal electrode 16 further, and insulating material 20A is formed, the edge side of everything but an internal electrode 16 set further is covered in the side face of another side, and insulating material 20B is formed. In addition, the case where simplified in drawing 1 and the laminating of the component plate of several layers is carried out is described.
[0015] And in each above-mentioned side face, the external electrodes 22A and 22B are formed in the height direction of a component so that it may intersect perpendicularly with each insulating material 20A and 20B, and it connects with the edge of the internal electrode 16 exposed in each side face in common, respectively. Therefore, it may have comes to impress a different polar electrical potential difference by turns to an internal electrode 16 by impressing a polar electrical potential difference which

is different in these external electrodes 20A and 20B.
[0016] On the other hand, in the side face of other couples which do not form the external electrodes 22A and 22B of a layered product 18, coating of the damp proof course 24 which consists of non-water permeability matter like inorganic glass is gone across and carried out to the whole surface, it is formed in it, and is raising moisture resistance. And in this damp proof course 24, many air bubbles 26 are arranged along all the exposure edges of an internal electrode 16 (refer to drawing 3). Thus, by arranging many air bubbles 26 in a damp proof course 24 When it expands and contracts in this die-length direction at the time of this component operation, the amount of telescopic motion of a damp proof course 24 can be permitted to some extent with air bubbles 26. Also when a crack arises in a damp proof course 24, without this amount of telescopic motion being nonpermissible, moreover, the array of the above-mentioned air bubbles 26 As an operation like the so-called perforated line is carried out and it is shown in drawing 4 , the crack 28 for flexible allowance occurs in accordance with this cellular array, and thereby, a damp proof course 24 is divided in the shape of [much] a strip of paper, and can permit the amount of telescopic motion of the component itself. That is, if it puts in another way, the generating direction of a crack 28 is controllable. In this case, this crack 28 can raise moisture resistance, without forming pass in a unlike pole of moisture, since an adjoining internal electrode is not straddled.
[0017] If the manufacture approach of the above displacement components 12 is explained concretely, while kneading the raw material powder which consists of Pb, Zr, and Ti oxide (PZT) with an organic binder like PVB etc., slurring it first and applying this by the thickness of about 100 micrometers on a sheet, the paste which consists of platinum or silver-palladium will be screen-stenciled on this front face, and an internal electrode 16 will be formed in it. Thus, after carrying out the laminating of the about 100 sheet metal with a thickness [in which the internal electrode 16 was formed] of about 100 micrometers, for example and sticking this by pressure, it calcinates by predetermined high temperature, for example, the piezo-electric layered product 18 of the shape of an about [5mmx5mmx10mm] rectangular parallelepiped is formed. In addition, the formation approach of the piezo-electric layered product 18 forms electrode paste in the front face by screen-stencil etc., after calcinating each ceramic sheet beforehand, as it is not limited to the above-mentioned approach, for example, is shown in JP,63-155684,A, and it carries out several multi-sheet adhesion immobilization of this with adhesives etc., and you may make it form a layered product 18. After forming in such a layered product 18 the insulating materials 20A and 20B and the external electrodes 22A and 22B which were mentioned above, the array of the above-mentioned damp proof course 24 and air bubbles 26 is formed before formation.
[0018] For this reason, the side face in which the external electrode of the layered product 18 which carried out the laminating of the piezoelectric-device object 14 and the internal electrode 16 by turns, and formed them as mentioned above first as shown in drawing 2 (A) is not prepared is ground with the powder 30 which consists of gas generating members, such as SiC (silicon carbide), as shown in drawing 2 (B). The mean particle diameter of SiC at this time is set as about 5-10 micrometers. The ceramic part of the comparatively soft and weak piezoelectric-device plate 14 is ground by this polish, it is comparatively hard and the edge 32 of the internal electrode 16 with ductility is exposed in the shape of a projection. And the powder 30 of the gas generating member which consists of SiC along this exposed internal electrode edge 32 as shown in drawing 2 (C) is made to adhere slightly.
[0019] Next, only predetermined thickness applies to the whole surface the glass layer 34 of the shape of a paste which is the non-water permeability matter as shown in this side face at drawing 2 (D) after washing the side face which this layered product ground. And after this, as the powder of SiC shows the above-mentioned glass layer 34 in the following formula (1) by the ability being burned at predetermined temperature, for example, 700 degrees C, it reacts with oxygen and CO2 is generated.
$SiC+2O2 \rightarrow SiO2+CO2$ ..... (1)
For this reason, as shown in drawing 2 (E), in a damp proof course 24, many air bubbles 26 will be generated along the edge 32 of an internal electrode 16, and these air bubbles 26 will be arranged by parallel in the shape of a straight line along with an internal electrode 16, as shown in drawing 3 .
[0020] Therefore, the array of these air bubbles 26 will carry out an operation of a perforated line, as shown in drawing 4 at the time of flexible operation of a component, a crack 28 will occur in accordance

with the array of air bubbles 26, and this amount of component telescopic motion will be permitted. Thus, since the generating direction of a crack 28 can be controlled, it can control that the crack which stands in a row does not generate the internal inter-electrode one of + and -, and + and - electrode short-circuit with moisture in a high humidity ambient atmosphere, and it becomes possible to raise moisture resistance.

[0021] Here, resistance to humidity with a component is explained to the above-mentioned example and a front face based on drawing 5 conventionally which has not performed any coating processing. In drawing 5 , a curve A1 shows this invention component at the time of using an internal electrode as platinum (Pt), a curve A2 shows this invention component at the time of making an internal electrode into silver-palladium, a curve B1 shows the conventional component at the time of using an internal electrode as platinum, and curvilinear B-2 shows the conventional component in case an internal electrode is silver-palladium, respectively. At this time, the applied voltage between + and - internal electrode is direct-current 150V, and the test atmosphere is 40 degrees C and 90%RH. Even if actuation time amount increases, the curves A1 and A2 of this invention component hold sufficient insulation resistance by receiving that insulation resistance falls rapidly as actuation time amount increases the curve B1 of a component, and B-2 conventionally, and the property which is not desirable is shown, so that clearly from this graph, and when platinum is used especially for an internal electrode, fluctuation of insulation resistance shows few good properties. Moreover, in this invention component, in the case of the curve A2 which used silver-palladium for the internal electrode, lowering of insulation resistance shows the property which was conventionally superior to the curve B1 of a component, and B-2, although generated.

[0022] In the above-mentioned example, although glass was used as construction material of a damp proof course 24, if it is the non-water permeability matter, it will not be limited to this. Moreover, although SiC similarly used also [abrasives] as a gas generating member was used, as long as it is the matter which may generate a gas in the time of heat treatment etc., what kind of thing may be used. In addition, if it is in the above-mentioned example, in order to prevent this, as a possibility that the pass which leads to - pole from + pole through the front face of a damp proof course may arise produces the component itself when immersed underwater, but it is shown in drawing 6 , for example from a crack occurring along with Aikata of + and - internal electrode edge, you may constitute.

[0023] Hereafter, an example 2 is explained based on drawing 6 and drawing 7 . In this example 2, only by meeting the edge of the internal electrode of +, or the edge of the internal electrode of -, air bubbles are formed selectively. That is, as shown in drawing 6 (A), after grinding the side face of a layered product 18 with the alumina system abrasive grain which presentation decomposition does not produce in an elevated temperature, for example, the White alundum abrasive grain, first, only the edge of the internal electrode of + pole forms the **-like nickel plating 36 only in the edge of the internal electrode of - pole using nickel which is a conductive member, using the electrolyte with which the powder of SiC which is a gas generating member was mixed. The case where plating 36 is formed along with + electrode in drawing 6 is shown. Although this nickel plating 36 can be selectively given to + and - pole, a metallic element ionizes to + ion, and if it takes into consideration carrying out migration to - pole, the direction of moisture resistance which performs nickel plating to - pole selectively will improve. And during this nickel plating 36, the powder-like gas generating member 30 will mix uniformly, and will be incorporated. At this time, the mean particle diameter of the powder of SiC sets up plating conditions as follows preferably 2 micrometers or less, for example. The temperature of an electrolyte was set as about 50 degrees C, plating processing was performed for about 3 minutes by current value 0.03A, and plating height was set to about 10-20 micrometers. Moreover, the amount of mixing of SiC is made into about 10wt% to an electrolyte, and plating processing is performed, stirring a solution.

[0024] Next, as shown in drawing 6 (B), by predetermined thickness, uniformly, the paste-like glass layer 34 is crossed to the whole surface, and is applied to the side face of the component which formed plating 36 as mentioned above. Then, as drawing 2 (E) explained, SiC which mixed the glass layer 34 in plating 36 while the damp proof course 24 was formed by the ability being burned at about 700-degree C elevated temperature reacts with oxygen like said formula (1), and it is CO2. It generates and the array

of air bubbles 26 is formed in this part. The condition at this time will be shown also in drawing 7 , and the array of air bubbles 26 will be formed only along with the internal electrode edge, for example, - electrode, set further. Therefore, at the time of component operation, a crack will occur in accordance with the array of these air bubbles 26 like a previous example. In this case, since the edge of + pole is thoroughly covered with the damp proof course 24 if it is in the electrode of another side, and the example of a graphic display, even if moisture adheres to this component front face, it becomes possible not to form the pass which leads between + and - pole, and to raise resistance to humidity further.

[0025] Here, resistance to humidity with a component is explained to the above-mentioned example and a front face based on drawing 8 conventionally which has not performed any coating processing. In drawing 8 , curvilinear A3 shows this invention component at the time of using an internal electrode as platinum, curvilinear A4 shows this invention component at the time of making an internal electrode into silver-palladium, and a curve B1 and B-2 show a component conventionally [the / same] as the case where it is shown in drawing 5 , respectively. The test condition is the same as that of the case where it is shown in previous drawing 5 . Two this invention components indicate that the insulation resistance of abbreviation regularity high regardless of actuation time amount is clear from this graph, and the good property is shown when platinum is used especially for an internal electrode. Moreover, curvilinear A3 of this example 2 and A4 show the high insulation resistance value rather than the case of the example 1 shown in drawing 5 , respectively, and it became clear that good resistance to humidity could be obtained. In addition, although there is a possibility of nickel plating carrying out migration and reducing damp-proof ability if it is in this example 2, the approach shown in drawing 9 may be used as an approach of forming air bubbles in the edge of the internal electrode which prevents this and is set further.

[0026] Hereafter, an example 3 is explained based on drawing 9 and drawing 10 . First, as shown in drawing 9 (A), it grinds with the powder 30 which consists of a gas generating member of SiC like the case where the side face in which the external electrode of a layered product 18 which carries out the laminating of the piezoelectric-device plate 14 and the internal electrode 16 by turns, and becomes is not prepared is shown in drawing 2 , and the powder 30 of the gas generating member which consists of SiC along all the internal electrode edges 32 exposed as shown in drawing 9 (B) is made to adhere slightly.

[0027] Next, as were shown in drawing 9 (C) and the example 2 was shown, only + electrode forms nickel plating 36 for setting further along the edge of only - electrode using an electrolyte. If it is in the example of a graphic display, the case where nickel plating is formed along the edge of + electrode is described. Moreover, the powder 30 which did not mix SiC into the electrolyte in this case unlike the time of an example 2, therefore adhered to the electrode edge 32 by nickel plating 36 will be covered thoroughly, and will be sealed.

[0028] Next, as shown in drawing 9 (D), the paste-like glass layer 34 is extensively applied to homogeneity. And a damp proof course 24 is formed by the ability burning the above-mentioned glass layer 34 at predetermined temperature, for example, 700 degrees C, after this. Under the present circumstances, the SiC powder 30 which adhered to the edge of - electrode if it was in the powder, i.e., example of a graphic display, of the part which is not covered with nickel plating 36 although the SiC powder covered with nickel plating 36 did not react at all reacts with oxygen like said formula (1), and is CO2. It will generate and the array of air bubbles 26 will be formed along with this part. Therefore, the array or crack of air bubbles 26 will be formed in the edge of the internal electrode similarly set further with having explained in the example 2 in this case, and if it is when moisture adheres to a component front face, it becomes possible to prevent that the pass which leads to + and - inter-electrode is generated. Since according to this example nickel plating 36 does not exist in the part which a crack generates, i.e., the part which air bubbles 26 generate, as explained previously, when the internal electrode 16 is especially constituted by platinum, there is no possibility that migration may arise, and it becomes possible to raise moisture resistance substantially.

[0029] Here, resistance to humidity with a component is explained to the above-mentioned example and a front face based on drawing 10 conventionally which has not performed any coating processing. In drawing 10 , curvilinear A5 shows this invention component at the time of using an internal electrode as

platinum, a curve A6 shows this invention component at the time of making an internal electrode into silver-palladium, and a curve B1 and B-2 show a component conventionally [the / same] as the case where it is shown in drawing 5 , respectively. The test condition is the same as that of the case where it is shown in previous drawing 5 . Two this invention components show the insulation resistance of abbreviation regularity high regardless of actuation time amount, especially both curvilinear A5 and A6 are higher than the case of the example 2 shown in drawing 8 respectively, and the stable insulation resistance is shown, and it became clear that good moisture resistance could be acquired so that clearly from this graph.

[0030]

[Effect of the Invention] As explained above, according to this invention, the operation effectiveness which was excellent as follows can be demonstrated. It can prevent that a crack will occur in accordance with the array of these air bubbles, and a crack occurs ranging over the electrode between unlike poles by forming many air bubbles into a damp proof course along the edge of an internal electrode. Therefore, between unlike poles, it can prevent that the pass by moisture is generated and moisture resistance can be raised substantially. Moreover, it can provide cheaply, without raising a manufacturing cost, since it is not necessary to perform processing with many routing counters like an electrophoresis method.

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CLAIMS

[Claim(s)]
[Claim 1] the laminating mold which prepared the external electrode which connects for setting further with this internal electrode in the side face of the layered product which comes to carry out the laminating of a piezoelectric-device plate and the internal electrode by turns -- a variation rate -- the laminating mold characterized by to have the damp proof course which consists of non-water-permeability matter formed in the side face in which said external electrode of said layered product is not prepared, in the component, and the air bubbles of a large number formed into said damp proof course along the edge of said internal electrode -- a variation rate -- a component.
[Claim 2] the laminating mold which prepared the external electrode which connects for setting further with this internal electrode in the side face of the layered product which comes to carry out the laminating of a piezoelectric-device plate and the internal electrode by turns -- a variation rate -- the laminating mold characterized by to have the damp proof course which consists of non-water-permeability matter formed in the side face in which said external electrode of said layered product is not prepared, in the component, and the crack for flexible allowance which were formed in said damp proof course along the edge of said internal electrode -- a variation rate -- a component.
[Claim 3] Said air bubbles are laminating type displacement components according to claim 1 characterized by the thing of said internal electrode which it is made to correspond for setting further and is formed.
[Claim 4] Said crack is a laminating type displacement component according to claim 2 characterized by the thing of said internal electrode which it is made to correspond for setting further and is formed.
[Claim 5] In the manufacture approach of the laminating type displacement component which carried out the laminating of a piezoelectric-device plate and the internal electrode by turns, and was carried out as [prepare / form a layered product and / in the side face of this layered product / the external electrode connected for setting further with said internal electrode] A gas generating member is formed along the edge of said internal electrode on the side face in which said external electrode of said layered product is not prepared. Subsequently The damp proof course which consists of non-water permeability matter is formed in the side face in which said foreign voltage of said layered product is not prepared. then, the laminating mold characterized by constituting so that many air bubbles may be formed into said damp proof course along the edge of said internal electrode by generating a gas from said gas generating member -- a variation rate -- the manufacture approach of a component.
[Claim 6] The manufacture approach of the laminating type displacement component according to claim 5 characterized by forming the crack for flexible allowance in accordance with the array of the air bubbles of said large number.
[Claim 7] the laminating mold according to claim 5 or 6 with which said air bubbles are characterized by the thing of said internal electrode which it is made to correspond for setting further and is formed -- a variation rate -- the manufacture approach of a component.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the perspective view showing the laminating type displacement component concerning this invention.
[Drawing 2] It is process drawing showing the production process of the displacement component shown in drawing 1 .
[Drawing 3] It is the outline top view of the displacement component shown in drawing 1 .
[Drawing 4] It is the top view showing a displacement component when a crack occurs.
[Drawing 5] It is the graph which shows the resistance to humidity of the displacement component of the example 1 of this invention.
[Drawing 6] It is process drawing showing the production process of the displacement component of the example 2 of this invention.
[Drawing 7] It is the outline top view of the displacement component shown in drawing 6 .
[Drawing 8] It is the graph which shows the resistance to humidity of the displacement component of the example 2 of this invention.
[Drawing 9] It is process drawing showing the production process of the displacement component of the example 3 of this invention.
[Drawing 10] It is the graph which shows the resistance to humidity of the displacement component of the example 3 of this invention.
[Drawing 11] It is the fragmentary sectional view showing the conventional laminating mold displacement component.
[Drawing 12] It is the fragmentary sectional view showing other conventional laminating type displacement components.
[Drawing 13] the conventional laminating mold of further others -- a variation rate -- it is the fragmentary sectional view showing a component.
[Drawing 14] It is the top view showing the crack disorderly generated in the glass membrane of a displacement component.
[Description of Notations]
12 Laminating Mold Displacement Component
14 Piezoelectric-Device Plate
16 Internal Electrode
18 Piezo-electric Layered Product
20A, 20B External electrode
24 Damp Proof Course
26 Air Bubbles
28 Crack
30 Powder (Gas Generating Member)
32 Edge
34 Glass Layer

36 Nickel Plating

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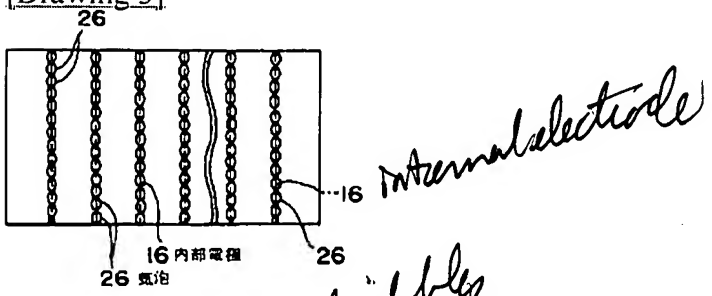
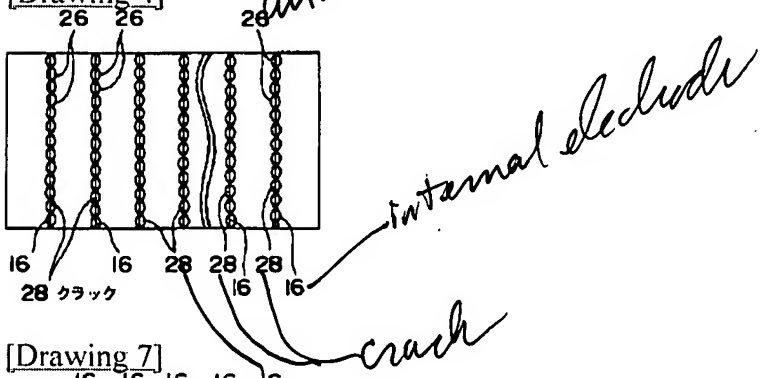
DRAWINGS

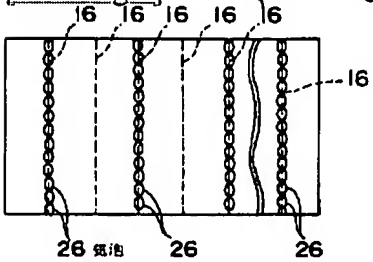
[Drawing 3]



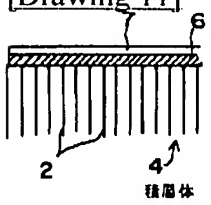
[Drawing 4]



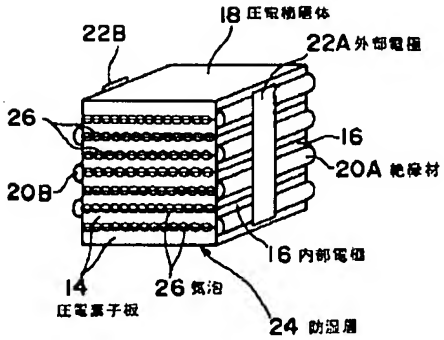
[Drawing 7]



[Drawing 11]

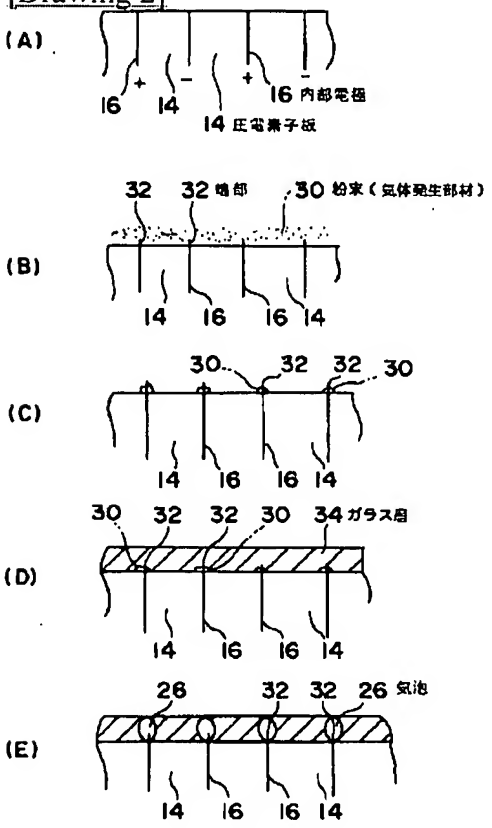


[Drawing 1]



12 積層型変位素子

[Drawing 2]



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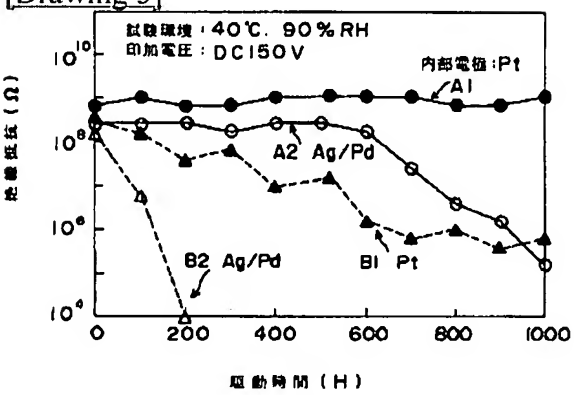

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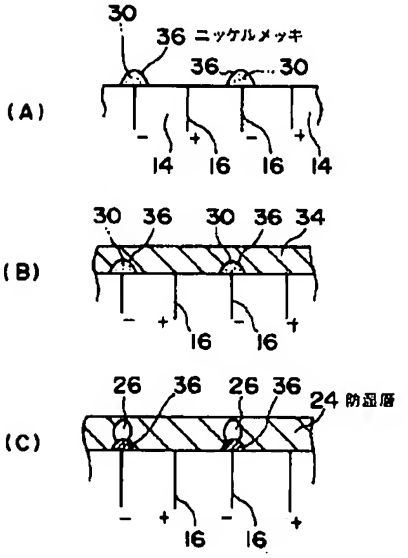
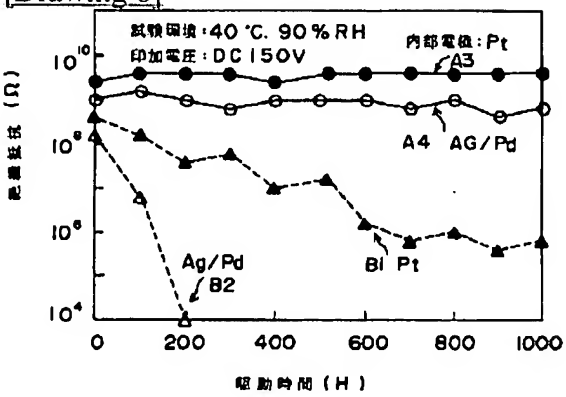
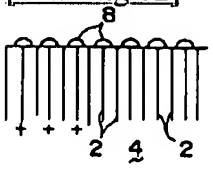


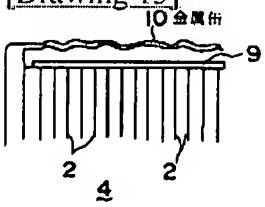
[Drawing 8]



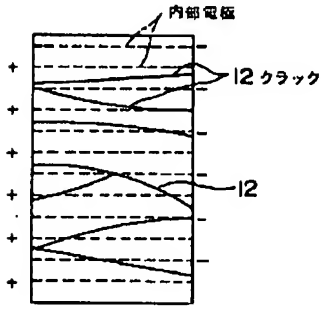
[Drawing 12]



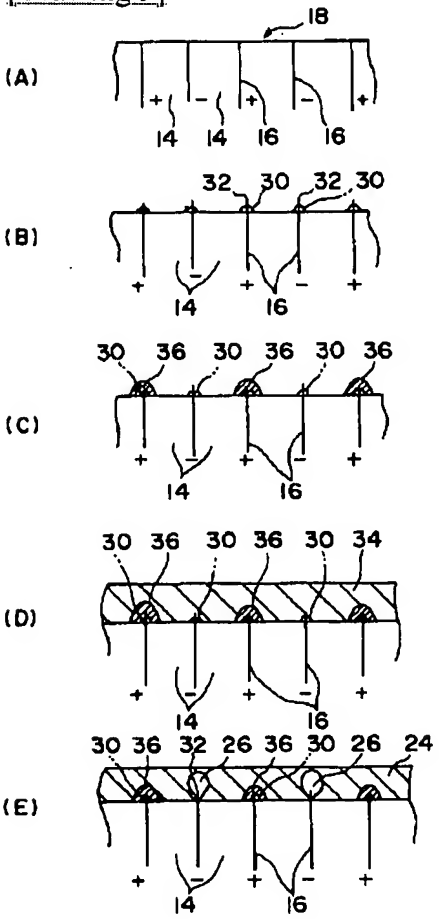
[Drawing 13]



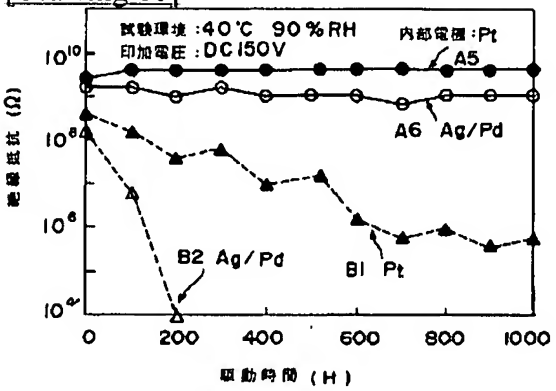
[Drawing 14]



[Drawing 9]



[Drawing 10]



[Translation done.]